

# Questionnaire Survey Regarding Prevention of Surgical Site Infection after Neurosurgery in Japan: Focus on Perioperative Management and Administration of Surgical Antibiotic Prophylaxis

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## Abstract

Various guidelines regarding surgical site infection (SSI) have recently been established. However, perioperative management of the wound and use of antibiotics have never been standardized completely in departments of neurosurgery in Japan. This survey investigated current perioperative management and administration of surgical antibiotic prophylaxis (SAP) and compared with guidelines intended to reduce SSI associated with neurosurgery in Japan. Questionnaires were distributed to members of the conference on Neurosurgical Techniques and Tools and the Japan Society of Aesthetic Neurosurgery via internet. The questionnaires asked about methods of perioperative management. A total of 255 members returned answers to the questionnaires. The questionnaires revealed that partial or no removal of the hair and hair shampooing at the day before surgery were performed in 96.1% and 88.1% of each institute following the World Health Organization (WHO) guidelines. Use of SAP at just before, during, and after surgery were 65.0%, 86.2%, and 63.0%, respectively. The postoperative period of use of intravenous SAP prolonged beyond 24 h in 80.0% against the recommendation of WHO. Perioperative management of wounds and use of SAP varies in institutes in Japan and some procedures were far different from the WHO guidelines. Japanese neurosurgeons should notice the prolonged SAP and comply with the WHO guidelines.

Key words: surgical site infection, perioperative management for wound, surgical antibiotics prophylaxis

## Introduction

Surgical site infection (SSI) is a significant factor in increased operative mortality and morbidity, hospital length of stay, readmission rate, and cost of care.<sup>1)</sup> SSI is relatively infrequent in neurosurgery, but generally results in substantial further care requirements, including readmission, reoperation, and intravenous antibiotic administration.<sup>2)</sup> Organized and prospective

surveillance of SSI can help to reduce its occurrence, by offering contemporary feedback on incidence and pooling data for analysis to help develop combative interventions.<sup>3–5)</sup>

Various guidelines and recommendation regarding SSIs have recently been established worldwide.<sup>6–8)</sup> However, the perioperative management of the surgical wound and the method of antibiotic administration in departments of neurosurgery are established by regulations specific to individual institutes in Japan. Therefore, research on perioperative management of surgical wounds and the methods of antibiotic administration are required for the standardization and development of methods for preventing SSIs.

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This survey revealed the current status of perioperative management and administration of surgical antibiotic prophylaxis (SAP), and made the comparison with the World Health Organization (WHO) guidelines to establish the basis for the development of guidelines for preventing SSIs after neurosurgery in Japan.

## Materials and Methods

Questionnaires were distributed to the members of the Conference on Neurosurgical Techniques and Tools (CNTT) and the Japan Society of Aesthetic Neurosurgery (JSAN) via internet from December 10, 2017 to January 31, 2018. Questionnaires were made using SurveyMonkey (URL: <https://www.surveymonkey.com/dashboard/>). The questionnaires included information about the respondents, age, sex, position, and facility information, and partial information about the methods of perioperative

management, preparation before surgery, such as how to remove the hair, and the method of antibiotic administration, including timing, interval, and period of SAP. The items of the questionnaires are shown in Table 1. In principle, the respondents were asked to answer based on the protocols for regular surgery, excluding emergent surgery and so on.

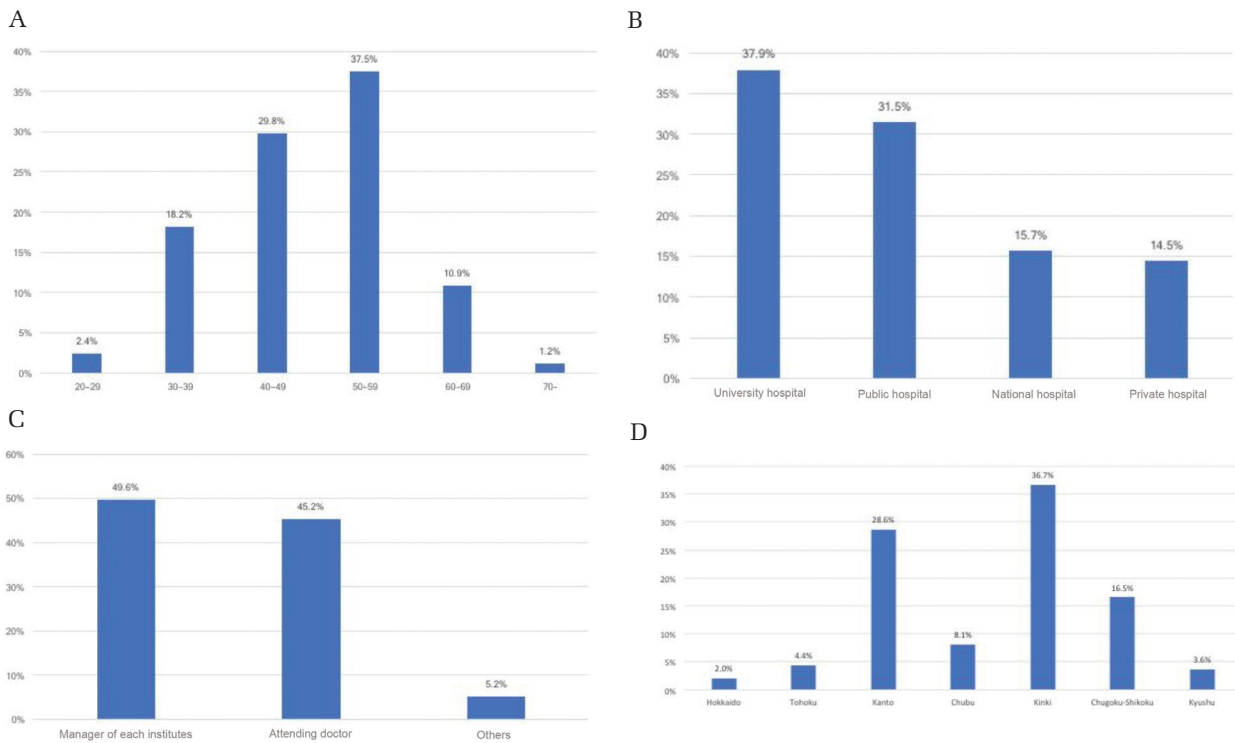
This study was approved by the Institutional Review Board of Hiroshima University (No. E-915) and the Boards of directors of CNTT and JSAN. Consent was regarded as implied by the answer to the questionnaire. The requirement for informed consent was waived because of the anonymous nature of the data.

## Results

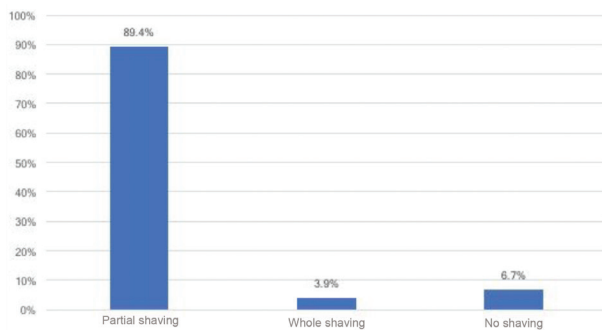
A total of 255 members answered questionnaires. Mean answering time was 8 min 9 s. The respondents were categorized based on age, institute, position,

**Table 1** Content of the questionnaire

Q1. How old are you?	Q8. What timing do you use surgical antibiotic prophylaxis? (multiple answers possible)
Q2. Are you male or female?	a) Previous day of operation
Q3. What type of institute are you employed at?	b) Just before operation
a) University hospital	c) Intraoperative period
b) Private hospital	d) Postoperative period
c) National hospital	Q9. How often do you use surgical antibiotic prophylaxis in the intraoperative period?
d) Public hospital	a) Every 2 h
Q4. What position do you hold in your institute?	b) Every 3 h
a) Chief/Manager	c) Every 4 h
b) Attending doctor	d) Every 5 h
c) Others	e) Every 6 h
Q5. What region do you work in?	f) Every 7 h
a) Hokkaido	g) Every 8 h
b) Tohoku	h) Every 9 h
c) Kanto	i) Every 12 h
d) Chubu	j) Others
e) Kinki	Q10. How long do you prolong surgical antibiotic prophylaxis in the postoperative period?
f) Chugoku-Shikoku	a) 1 day
g) Kyushu	b) 2 days
Q6. How do you remove the hair before operation?	c) 3 days
a) Whole of head	d) 4 days
b) Partial	e) 5 days
c) No	f) 7 days
Q7. Do you shampoo the patient's hair on the day before operation?	g) others
a) Yes	
b) No	



**Fig. 1** (A) Distribution of age of responders. (B) Type of institutes, public or private, of responders. (C) Position of respondents at each institute. (D) Region of institutes of responders.



**Fig. 2** Extent of removing shaving hair.

and region. Respondents in their 50s were the largest group at 37.5% (Fig. 1A), the institutes were most numerous in the order of university hospital (37.9%) and private hospital (31.5%) (Fig. 1B), the position of the respondents was manager of institute (49.6%) and attending doctor (45.2%) (Fig. 1C), and the most common regions were Kinki (36.7%), Kanto (28.6%), and Chugoku-Shikoku (16.5%) (Fig. 1D).

Figure 2 shows the methods of removing the hair, with total removal of the hair at 3.9%, partial removal at 89.4%, and no removal at 6.7%, indicating some removal in 93.3%. Shampooing on the day before operation was used in 88.1% (Fig. 3A)

and just after surgery in 35.7% (Fig. 3B). Use of SAP under actual clinical conditions occurred on the previous day of operation in 0.4%, just before operation in 65.0%, intraoperatively in 86.2%, and postoperation in 63.0% (Fig. 4A). Intraoperative administration occurred at 2-h intervals in 0.4%, 3-h intervals in 63.8%, 4-h intervals in 16.1%, 5-h intervals in 1.2%, 6-h intervals in 11.1%, 8-h intervals in 2.5%, and 12-h intervals in 3.3%, indicating SAP over every 4 h in 34.2% (Fig. 4B). The period of administration of SAP was 1 day (20.0%), 2 days (20.8%), 3 days (40.0%), 4 days (5.0%), 5 days (8.3%), 1 week (5.0%), and other (0.8%), indicating SAP prolonged beyond 24 h after completion of surgery in 80.0% (Fig. 4C).

## Discussion

Surgical site infection is a dangerous complication of any surgery, and may result in prolonged hospitalization, additional costs, and higher mortality and morbidity.<sup>1,9-11)</sup> The rates of SSIs associated with neurosurgery are reported as 1–8% for cranial procedures and 0.5–18.8% for spinal procedures.<sup>11)</sup> Various preventive measures to mitigate the risk of SSI have been recommended based on the findings of clinical trials.<sup>9-21)</sup> This survey investigated current

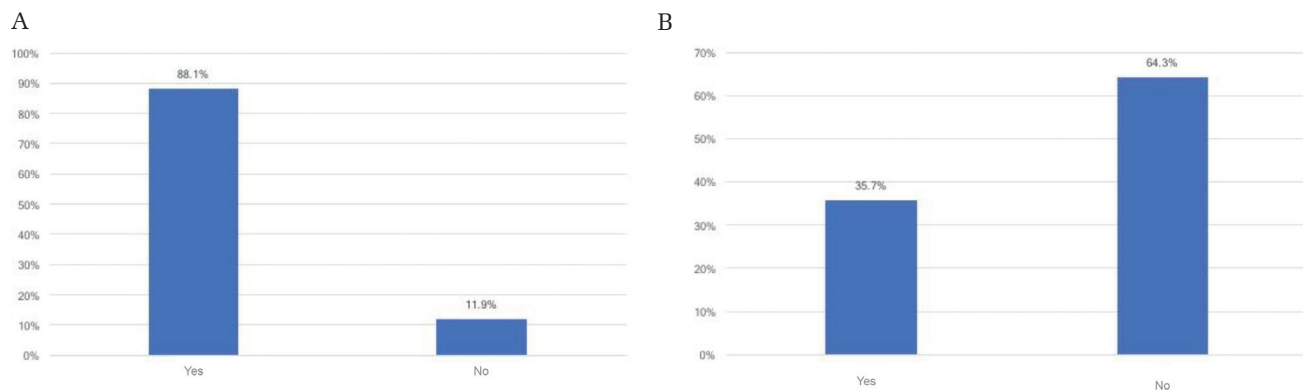


Fig. 3 (A) Shampooing on the day before operation. (B) Shampooing just after operation.

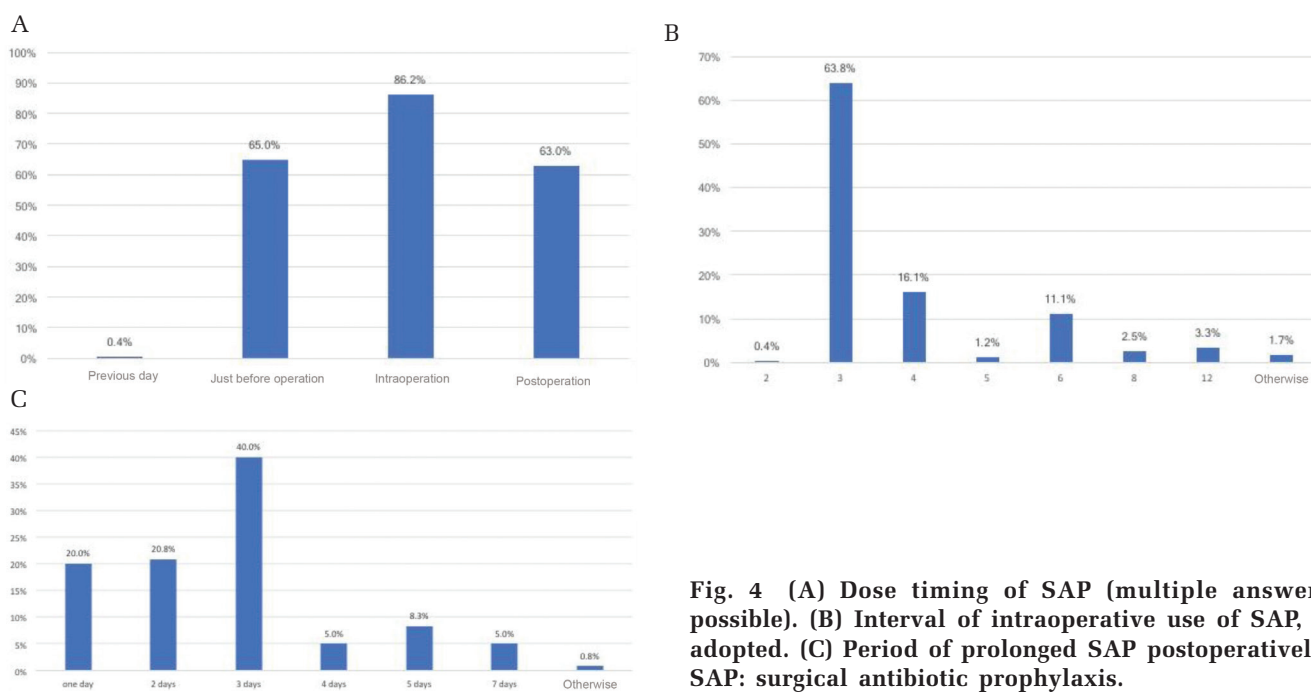


Fig. 4 (A) Dose timing of SAP (multiple answers possible). (B) Interval of intraoperative use of SAP, if adopted. (C) Period of prolonged SAP postoperatively. SAP: surgical antibiotic prophylaxis.

perioperative management and SAP administration protocols intended to prevent SSI after neurosurgery in Japan. The survey found considerable variations in timing, interval, and period of SAP among the respondents.

Removal of hair from the intended site of surgical incision has been conventional in the routine preoperative preparation of patients. Although hair removal might be required for adequate exposure and preoperative skin marking, any microscopic trauma of the skin could increase the risk of SSIs.<sup>22–25</sup> Five recent randomized controlled trials (RCTs) or quasi-RCTs compared the effects of preoperative hair removal and no hair removal, or hair removal using shaving, clipping, and depilatory cream. Hair removal did not affect the incidence of SSIs compared with no hair removal, with the

quality of evidence rated as moderate.<sup>12–15</sup> However, clipping or no hair removal significantly reduced SSIs compared with shaving. Therefore, the WHO guidelines recommend that hair should not be removed, or only removed with clippers. Shaving is strongly discouraged at all times, including preoperatively or in the operating room. This survey found that 3.9% of responders removed hair totally in spite of this guideline, and this method should be discouraged. In contrast, 89.4% of responders removed hair partially, to facilitate skin marking and surgical manipulation, but clipping is the only acceptable method of partial hair removal. The recommendation for partial removal or no removal in neurosurgery remains controversial and requires further investigation.<sup>26</sup> This questionnaire did not ask for details of hair removal, such as clipping,

shaving, or depilatory cream, so a future survey should include these questions.

Preoperative whole-body bathing or showering is accepted good clinical practice to ensure cleanliness of the skin before surgery and to reduce the bacterial load, particularly at the incision site. Three observational studies found that cleaning with chlorhexidine gluconate reduced the incidence of SSIs compared with no bathing, but the evidence was considered low quality.<sup>27,28)</sup> The WHO guidelines recommend bathing or showering using plain or antiseptic soap prior to surgery, but the evidence was insufficient to recommend the use of chlorhexidine gluconate-impregnated cloths. The Centers for Disease Control and Prevention (CDC) also recommend full body bathing or showering with either antimicrobial or nonantimicrobial soap or antiseptic agent at least by the night before the operative day.<sup>7)</sup> This survey found that 88.1% of responders followed the recommendation about bathing or showering before surgery, whereas 11.9% used no shampooing on the day before operation, so shampooing should be encouraged.

Surgical antibiotic prophylaxis refers to the prevention of infectious complications by administration of antimicrobial agents before possible contamination during surgery.<sup>29)</sup> Successful SAP requires intravenous administration of effective concentrations of the antimicrobial agent to the operative site at the appropriate time. Several observational studies have investigated SAP,<sup>17–21)</sup> but no RCTs or studies in the pediatric population are available. SAP administration after incision was associated with significantly higher incidence of SSI compared with administration before incision, but the evidence was low quality. SAP administration earlier than 120 min before incision was associated with significantly higher prevalence of SSI compared with administration within 120 min, based on moderate quality evidence. Therefore, more effective administration at <120 min before incision cannot be established, and the conventional timing within 60 min before incision is not supported by the evidence. Microbial agent half-life, underlying condition(s) of the patient (e.g., body mass index, or renal or liver function), time needed for the surgery, and antibiotic protein binding must be considered to achieve adequate serum and tissue concentrations at the surgical site from incision to wound closure to prevent incisional SSI. Most guidelines recommend a single preoperative dose, followed by intraoperative doses if the procedure time exceeds two half-lives of the agent, or if excessive blood loss occurs.<sup>17–21)</sup> For example, cefazolin (CEZ), targeted to Gram-positive staphylococci with half-life of 1.8 hours, is administered 120 min before skin incision and then every 3 h.

CEZ administration should be continued up to 24 h. This survey found that only 65.0% of responders administered SAP before skin incision, 86.2% used intraoperative doses, and only 34.2% of responders continued SAP every 4 h. RCTs have shown that SAP continued postoperatively has no benefit in reducing SSI after surgery compared with only intraoperatively, and no benefit by prolonging SAP beyond 24 h after surgery compared with up to 24 h.<sup>30–36)</sup> The WHO guidelines discourage prolongation of SAP administration after completion of surgery, even in the presence of drainage.<sup>37–42)</sup> The CDC agrees with this finding.<sup>7)</sup> However, this survey found that 80% of responders prolonged SAP beyond 24 h after completion of surgery, and 20.3% continued SAP for over 4 days after surgery. Neurosurgeons are extremely concerned about SSI, so tend to prolong SAP for security. However, such prolongation of SAP may increase the likelihood of complications as opposite effect, therefore, we should limit the SAP within 24 h to comply with the WHO guidelines.

### Limitations

This preliminary survey had only 255 respondents, with only 29.2% of all 872 training facilities, so the findings may not reflect the general conditions in Japan and further survey is necessary. This survey had several biases regarding institutes and regions. This questionnaire survey also lacked some important questions: 1) what is the method of removing the hair? 2) Do you change the use of SAP in the presence of a drain. So the next survey of SSI and management of SAP should include more questions.

### Conclusion

The perioperative management of surgical wounds and use of SAP varies in many institutes in Japan and some procedures were far different from the WHO guidelines. Japanese neurosurgeons should notice the less effectiveness of prolonged SAP and comply with the WHO guidelines.

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### Contributors

All authors have made substantial contributions to the intellectual content of the paper, have approved the final manuscript, and agree with submission to this journal. Fusao Ikawa is the corresponding author



for this study and the principal investigator. He takes responsibility for data management, accuracy of statistical analysis, conduct of the research, and drafting of the manuscript.

## Conflicts of Interest Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper. All authors who are members of The Japan Neurosurgical Society (JNS) have registered online Self-reported COI Disclosure Statement Forms through the website for JNS members.

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